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COMMITTEE ON THE DEVELOPMENT
AND UTILIZATION OF NEW AND
RENEWABLE SOURCES OF ENERGY
Sixth session
3-14 February 1991
Item 3 of the provisional agenda*

IMPLEMENTATION OF THE NAIROBI PROGRAMME OF ACTION FOR THE DEVELOPMENT AND UTILIZATION OF NEW AND RENEWABLE SOURCES OF ENERGY

Progress achieved in the follow-up of substantive themes selected for detailed consideration by the Committee at its fourth and fifth sessions

Report of the Secretary-General

INTRODUCTION

1. The Committee on the Development and Utilization of New and Renewable Sources of Energy, at its fifth session, requested the Secretary-General to prepare a report on the progress achieved in the follow-up of substantive themes selected by the Committee for detailed consideration at its fourth and fifth sessions. 1/ The present report has been prepared in response to that request.

SPECIFIC FOLLOW-UP ACTION

2. At its fourth session, the Committee considered the themes (a) Research, development and demonstration and (b) Information systems in the field of new and renewable sources of energy. The Committee had before it a report of the

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* A/AC.218/1992/1.

Secretary-General on the activities of the United Nations system in those two areas (A/AC.218/13); with regard to theme (a), it also had before it the conclusions and recommendations of the Castel Gandolfo Colloquium of High-level Experts on New and Renewable Sources of Energy (see A/AC.218/14).

3. With regard to the theme "Research, development and demonstration", it will be recalled that follow-up activities were considered by the Committee at its fifth session, particularly in the context of the progress achieved in implementing the recommendations of the Castel Gandolfo Colloquium (see A/AC.218/1990/2). The Committee was informed at that time that steps had been taken to identify institutions for inclusion in the network of centres of excellence. A study of the Consultative Group on International Agricultural Research Centres and their experience had been undertaken and a list of institutions in developing countries compiled, including several hundred of those actually involved in research and development in the area of new and renewable sources of energy.

4. Subsequently, a pre-feasibility study on centres of excellence was considered by the Consultative Group on New and Renewable Sources of Energy at its meeting held in Rome in March 1991. The Group decided to proceed with the feasibility study which would include the financial aspects, funding and final identification of the centres of excellence, and entrusted its Chairman with the responsibility for further follow-up in that regard.

5. With regard to information systems, it may be recalled that a number of Governments were approached to fund and host an ad hoc panel of experts. Consultations have continued but so far no Government has been forthcoming in providing the funding for or acting as host to such a group.

6. At its fifth session, the Committee considered the themes (a) Contribution of new and renewable sources of energy to integrated rural development; (b) Direct solar-to-electrical energy conversion and (c) Utilization of agricultural residues and urban wastes for energy production.

7. In connection with the first of the above-mentioned themes, the Committee had before it a note by the Secretary-General transmitting the report of the United Nations Group of Experts on the Role of New and Renewable Sources of Energy in Integrated Rural Development, which met at Stockholm in January 1990 (A/AC.218/1990/4). The Committee endorsed the proposals for further action contained in that report and requested the Secretary-General to entrust relevant entities within the United Nations system with the preparation of project and programme proposals, in accordance with the national development plans, objectives and priorities of the developing countries concerned. During the tenth session of the Inter-Agency Group on New and Renewable Sources of Energy of the Administrative Committee on Coordination, held at Geneva in March 1991, the attention of the group was drawn to the decision of the Committee and the various bodies concerned were requested to prepare project and programme proposals, in accordance with that decision.

8. The proceedings of the Stockholm meeting are being published under the title Energy for Rural Development by Zed Books in London, with generous financial support from the Swedish Agency for Research Cooperation with Developing Countries. The book will be widely distributeed to field workers, policy-makers and decision-makers in both developed and developing countries, and to organizations active in the field of new and renewable sources of energy.

9. With regard to the theme "Direct solar-to-electrical energy conversion", the Committee, at its fifth session, considered the report of the Secretary-General on the subject (A/AC.218/1990/6); the report was based on a more detailed study commissioned by the Department of International Economic and Social Affairs of the United Nations Secretariat. The Committee welcomed the report and recommended the publication of the full study commissioned by the Department. Pursuant to that recommendation the Secretariat is publishing the full study for wide distribution under the title The Direct Conversion of Solar Energy to Electricity.

10. The Committee, also at its fifth session, considered the report of the Secretary-General on the utilization of urban wastes for energy production (A/AC.218/1990/7). In that connection, it considered that more work should be done in such areas as data collection for use in defining potential options, the development of systems suitable for application in developing countries, the promotion of pilot demonstration projects in those countries and the coordination of efforts among them. Some Governments have provided additional information on their activities in that regard. Information in this area from developing countries has, however, been meagre.

Notes

1/ Official Records of the General Assembly, Forty-fifth Session, Supplement No. 36 (A/45/36), annex, sect. 3.

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COMMITTEE ON THE DEVELOPMENT AND
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COMMEMORATION OF THE TENTH ANNIVERSARY OF THE ADOPTION OF THE NAIROBI PROGRAMME OF ACTION FOR THE DEVELOPMENT AND UTILIZATION OF NEW AND RENEWABLE SOURCES OF ENERGY

Report of the Intergovernmental Group of Experts on New and Renewable Sources of Energy

CONTENTS

	Paragraphs	Page
INTRODUCTION	1 - 2	3
I. NAIROBI PROGRAMME OF ACTION FOR THE DEVELOPMENT AND UTILIZATION OF NEW AND RENEWABLE SOURCES OF ENERGY	3 - 4	3
A. Objectives	3	3
B. Policy areas and areas for priority action	4	3
II. WORLD ENERGY SITUATION AND PROSPECTS SINCE 1981	5 - 16	4
A. Energy situation and trends	5 - 11	4
B. Trends in the production and use of new and renewable sources of energy	12 - 16	5

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CONTENTS (continued)

		Paragraphs	Page
III.	PROGRESS ACHIEVED DURING THE 1980s	17 - 97	6
	A. Overall assessment	17 - 35	6
	B. Specific new and renewable sources of energy	36 - 97	11
IV.	FACTORS BEARING ON THE IMPLEMENTATION OF THE NAIROBI PROGRAMME OF ACTION	98 - 147	23
	A. Policy factors	98 - 103	23
	B. Institutional factors	104 - 109	24
	C. Inter-agency coordination	110 - 111	26
	D. Financial factors	112 - 127	26
	E. Commercialization and marketing factors	128 - 131	30
	F. Techno-economic factors	132 - 135	31
	G. Manufacturing capabilities and possibilities	136 - 140	32
	H. Socio-cultural factors	141 - 143	33
	I. Environmental factors	144 - 147	33
V.	RECOMMENDATIONS	148 - 172	34
	A. Action at the national level	150 - 157	35
	B. Action at the international level	158 - 172	36
Annex.	List of participants		39

INTRODUCTION

1. The Committee on the Development and Utilization of New and Renewable Sources of Energy, at its fifth session, from 26 March to 4 April 1990, decided, inter alia, to include the item entitled "Commemoration of the tenth anniversary of the adoption of the Nairobi Programme of Action for the Development and Utilization of New and Renewable Sources of Energy" in the agenda of its sixth session, to be held in 1992. The Committee decided to convene an intergovernmental expert group meeting in 1991 to assess and review the process of implementation of the Nairobi Programme of Action and to make concrete recommendations on all aspects of its implementation, including institutional ones, with a view to assisting the Committee at its sixth session in the consideration of the item, and to take measures designed to speed up the implementation of the concerted measures envisaged in the Programme of Action. 1/ The decision of the Committee was endorsed by the General Assembly in its resolution 45/208 of 21 December 1990.

2. The Intergovernmental Group of Experts on New and Renewable Sources of Energy met in New York from 26 to 30 August 1991. The present report was approved by the Group (see the annex below for the list of participants). The report provides an assessment of the progress achieved in the implementation of the Nairobi Programme of Action during the 1980s, as well as recommendations for future action aimed at speeding up the implementation of the concerted measures envisaged in the Programme of Action.

I. NAIROBI PROGRAMME OF ACTION FOR THE DEVELOPMENT AND UTILIZATION OF NEW AND RENEWABLE SOURCES OF ENERGY

A. Objectives

3. The fundamental objective of the Nairobi Programme of Action for the Development and Utilization of New and Renewable Sources of Energy, which was adopted by the United Nations Conference on New and Renewable Sources of Energy, held in Nairobi from 10 to 21 August 1981, 2/ and by the General Assembly in resolution 36/193 of 18 February 1982, is to promote concerted action in the context of energy transition and the development and utilization of new and renewable sources of energy, with a view to helping meet future overall energy requirements, especially those of the developing countries.

B. Policy areas and areas for priority action

4. Five broad policy areas were identified in the Programme of Action for concerted action, all of which involved the support of the international community according to national plans and priorities. They are: (a) energy assessment and planning; (b) research, development and demonstration; (c) transfer, adaptation and application of mature technologies; (d) information flows; and (e) education and training. According to the

Nairobi Programme of Action, priority action should cover the above five policy areas, with emphasis on actions and programmes that are deemed to require more urgent attention. In particular, meeting rural energy requirements within the context of integrated rural development programmes is deemed to be of great urgency, especially for developing countries. This should be done according to the needs and priorities of the countries concerned.

II. WORLD ENERGY SITUATION AND PROSPECTS SINCE 1981

A. Energy situation and trends

5. The critical global energy situation that led to the subsequent formulation of the Nairobi Programme of Action in 1981 has, since then, been subject to drastic changes, with an unfavourable impact on the implementation of the Programme of Action. Energy programmes and policies, initiated world wide under conditions of high oil prices and reduced economic growth rates, led to diminished energy demand and a considerable decline in oil consumption, which was more pronounced in the developed market economies. Energy intensity (energy/gross domestic product (GDP) ratio) in the developed countries decreased, partly owing to the successful implementation of energy efficiency programmes and structural changes in their economies. Between 1979 and 1985, the world's energy consumption increased on average by only 1.3 per cent per annum; the rate of increase was 4.6 per cent in the developing countries, as compared with -0.5 per cent in the developed market economies. Oil production fell from 65.8 million barrels a day in 1979 to 56.6 million barrels a day in 1985, which led to a substantial glut in the international markets. The price of oil, which was about $35 a barrel in December 1980, declined gradually and then fell to less than $10 a barrel in mid-1986. Currently, it has settled at a range of $18 to $21 a barrel.

6. The excess oil supplies and the sharp decline in oil prices had a far-reaching impact on the global energy scene. The new situation altered energy policies and programmes, thereby reducing the support of energy alternatives and indigenous sources of energy, discouraging efficiency efforts, reducing the trend towards energy self-reliance, and again raising dependence on fossil fuels, particularly petroleum.

7. Meanwhile, many developing countries experienced growing commercial energy consumption. The rate of growth of commercial energy consumption in the developing countries averaged 5.5 per cent per annum during the period 1974-1989, compared to 5.3 per cent during 1960-1973, despite the fact that the rate of their annual GDP growth declined to an average of 3.7 per cent from 5.6 per cent during the corresponding period. As a result, energy intensity in those countries rose to nearly 1.5 per cent for the period 1974-1989 from 0.95 for 1960-1973. Nevertheless, the level of per capita commercial energy consumption in the developing countries remains very low. In Africa, the level was 178 kilograms of oil equivalent in 1989, as compared with 455 kg for developing countries in Asia and 2,160 kg in Latin America.

The corresponding figure for the United States of America was 7,090 kg. However, the consumption of traditional energy sources, which are not included in these figures, played an important role in the energy consumption of most developing countries.

8. The differences in the energy situation for various groups of countries led to considerable shifts in their positions in the global energy consumption picture, with developing countries emerging as the major user of additional world energy supplies. There was little change in the distributive share of each major country grouping in total energy consumption for about 15 years prior to 1973, but in subsequent years the share of developed market economies declined from 63 to 50 per cent between 1973 and 1989, while the share of developing countries jumped from 15 to 25 per cent. These trends also affected the energy self-reliance of the net energy-importing countries, leading to increasing dependence on foreign sources of energy.

9. Global energy demand is expected to grow in the coming decades. The World Energy Council, at its meeting in 1989, concluded that, if prevailing trends continued, energy needs would increase by about 75 per cent by the end of the next three decades. It also concluded that additional energy needs would be met mainly by existing conventional sources of energy. Developing countries were expected to register higher growth rates in energy demand than other groups of countries.

10. Such a scenario for future global energy development will continue to expose the world economy to great uncertainties of possible energy instabilities and increasing environmental degradation. Under the circumstances, accelerating the development and utilization of environmentally benign new and renewable sources of energy has become an urgent issue in regard to providing additional and environmentally acceptable energy for economic development in the decades to come.

11. As a result of considerable technological advances, new and renewable sources of energy create new options for viable and economical use in various application sectors which respond to the energy requirements of urban as well as rural areas. The development of new and renewable sources of energy will require new political, social, economic and environmental policy orientations through national action, as well as cooperation and assistance from the international community.

B. Trends in the production and use of new and renewable sources of energy

12. Over the past 10 years there has been an increase in some countries in the development and utilization of new and renewable sources of energy. The rate of increase nas varied, but, on the whole, it has been slow, especially since the mid-1980s.

13. The annual contribution of new and renewable sources of energy represents about 13-14 per cent of total energy supplies. 3/ Firm figures on the production of new and renewable sources of energy, in particular traditional sources, are, however, difficult to obtain. On the basis of available data, the share of new and renewable sources of energy in the developing regions has remained largely unchanged over the period 1980-1985. In those regions, new and renewable sources of energy - mainly traditional sources - provide an average of some 30 per cent of consumed energy - approximately 57 per cent in Africa, 38 per cent in Latin America and 20 per cent in Asia and the Pacific.

14. During the first half of the 1980s, progress was made in large-scale applications of mature technologies such as hydropower and geothermal electricity. Solar thermal technologies and wind electric farms have reached maturity. Numerous activities have taken place on small-scale new and renewable sources of energy applications; however, their overall impact on the global availability of energy remains insignificant. Small-scale hydropower, for which no data was available in 1981, currently represents a non-negligible supply of energy. Geothermal energy production, still small in absolute terms, increased by 60 per cent during the period 1980-1985, and has further increased by 48 per cent since that time. This increase reflects active development in such countries as Kenya, Mexico and the Philippines.

15. The production of peat and oil-shale declined by some 30 per cent between 1981 and 1985, and since then, affected most likely by the direct competition of other fuels and negative environmental effects, may have declined further.

16. The output of alcohol for energy purposes nearly tripled, mainly owing to the rapid expansion of the Brazilian programme of gasoline substitution. Energy from bagasse increased by some 53 per cent during the period 1980-1985 and is used in the form of steam and process heat by the sugar industry, as well as for electricity generation. Traditional sources of energy, which include fuelwood, charcoal, draught animal power and agricultural and animal residues, represent the largest share among new and renewable sources of energy. Energy supplies from fuelwood and charcoal are estimated to have provided the equivalent of over 500 million metric tons of oil in 1985 and 377 in 1990. The increased use of fuelwood, charcoal and agricultural and animal residues for energy in developing countries, however, resulted in a deterioration of living and environmental conditions.

III. PROGRESS ACHIEVED DURING THE 1980s

A. Overall assessment

17. Progress has been achieved at the national level, supported in some cases through bilateral and multilateral cooperation, but actual results fell well below expectations. A few countries have made significant progress, notwithstanding the fact that they faced severe economic constraints during the past decade. The United Nations system has undertaken a wide range of activities to assist efforts in respective countries.

1. Energy assessment and planning

18. During the 1980s, attention given to, and progress achieved in, energy assessment and planning, world wide, has been substantial. Most developing countries have taken steps to develop energy policies and plans appropriate to their needs and special circumstances. Nevertheless, progress in the incorporation of new and renewable sources of energy in national energy plans and programmes, and development of an integrated approach to energy planning, has been limited. A number of countries and regional institutions have not only improved the database pertaining to energy demand and supplies but have also made significant progress in building up the data infrastructure for new and renewable sources of energy. In those countries, data and feedback from ongoing programmes are providing a basis for assessing the possible role of new and renewable sources of energy within integrated national policies and plans. Significant progress has been made on surveys to obtain data on solar, wind, biomass and hydropower resources and on the assessment of geothermal potential.

19. While interest in new and renewable sources of energy has grown because they are environmentally attractive, this has not been adequately translated into energy policy and planning. The serious nature of the fuelwood supply problem and the environmental consequences of its unplanned utilization have prompted countries to bring the matter within the scope of national energy planning. Supportive action taken by the entities of the United Nations system has been well received by the developing countries. In particular, the activities of the joint United Nations Development Programme (UNDP)/World Bank Energy Assessment and Energy Sector Management Assistance Programme and the technical cooperation of many other entities of the United Nations system, including the regional commissions, have been successful in assisting a number of countries in determining critical areas of policy and planning and in evolving appropriate measures to better manage the energy sector.

2. Research, development and demonstration

20. Numerous research, development and demonstration activities were undertaken world wide, most have been pursued in the developed countries. New and renewable sources of energy technologies were demonstrated in various developing countries; several countries, in particular Brazil, China, India and Egypt, have established specialized centres and organizations to strengthen those capabilities in the field. Although some projects undertaken by the United Nations system have focused on strengthening national research and development capabilities, developing countries still need substantial support in that area.

21. A large number of projects were undertaken in developing countries for the demonstration and testing of new and renewable sources of energy technologies, specifically solar thermal, photovoltaic, biomass, fuelwood and geothermal technologies, through national and bilateral cooperation and United Nations organizations. In most of the cases, the linkage between research,

development and demonstration, on the one hand, and technology transfer and commercialization, on the other, failed to take root since most of the demonstration projects were pursued as ends in themselves rather than as means to facilitate technology transfer. In other cases, research and demonstration projects have strengthened local capabilities and led to technology transfer and local manufacture. In this respect, solar low-temperature and industrial process heating systems were developed and commercialized in many countries; wind power projects in the United States of America, various European countries, India, Egypt and Jordan were also developed.

22. After 1986, financial support for research, development and demonstration in the field of new and renewable sources of energy declined sharply. That led to a loss of momentum in the progress achieved during the early 1980s. More funds are needed to initiate action on measures identified in the Nairobi Programme of Action, at all levels, to maintain the momentum for those activities, in particular for appropriate mature technologies in each country. This should promote the effective integration of new and renewable sources of energy technologies into the national energy plan and reduce the negative environmental effects of the extensive use of other energy sources.

23. At the regional level, the establishment and strengthening of regional centres and networks will provide a basis for promoting cooperative research in this area. The activities undertaken so far by the Economic and Social Commission for Asia and the Pacific (ESCAP), the Economic and Social Commission for Western Asia (ESCWA), the Economic Commission for Latin America and the Caribbean (ECLAC) and the Economic Commission for Europe (ECE) have contributed to establishing the basis for joint research involving an exchange of regional information.

3. Transfer of technology, adaptation and application of mature technologies

24. Activities undertaken world wide to promote technology transfer have been considerable. These efforts included international exhibitions and demonstration of mature technology. Some joint ventures in solar heating, photovoltaics, hydropower, wind, geothermal and biomass technologies have materialized, largely through private sector initiatives, permitting interaction between interested parties and an evaluation of technologies under local conditions. However, only a limited number of technologies were sufficiently adapted and widely applied, owing in part to the fact that they were pursued as isolated activities rather than as an integral part of a wider programme.

25. At the national level, some developing countries adopted promotional measures, including incentives, improved licensing arrangements and market support regulations to encourage local manufacture and marketing. In addition, several countries have initiated major programmes for the application of mature technologies, which, if financially supported, could make a significant impact. Programmes such as those in Brazil, China, India

and Egypt are supported by the requisite technology base already in place, which can absorb more technologies and adapt them to local conditions. Nevertheless, the widespread use of new and renewable sources of energy needs to be further promoted through legal, administrative and financial measures, such as relief from customs duties.

26. Activities related to transfer of technology cooperation among the developing countries have been modest.

27. There has been a slowing down of application programmes in a number of developed countries; nevertheless, some of those activities and programmes have led to applications of mature technologies. At the multilateral level, the application of mature technologies, such as alcohol projects in Brazil and several hydropower and geothermal projects, have been supported.

4. Education and training

28. Assessment of manpower and training needs in the field of new and renewable sources of energy was not developed sufficiently at the national level. International organizations such as the International Labour Organisation (ILO) and the Food and Agriculture Organization of the United Nations (FAO) have provided guidelines for assessment and have incorporated training aspects within their activities.

29. The progress achieved at the bilateral and multilateral levels in the promotion of human resources development has been mainly through the incorporation of training and educational activities into the programmes and projects executed by donor countries and agencies - including fellowships, study tours, training workshops and participation in international conferences. At the regional level, ESCAP, ECLAC, ESCWA and ECE have made significant contributions in promoting education and training through regional training workshops and network activities, reflecting increasing interest in environmental issues, women's welfare and social and cultural factors in relation to development.

30. At the national level, education and training activities have scarcely increased; most activities are linked to specific programmes and have not yet resulted in the intensive incorporation of new and renewable sources of energy in the education system. However, in higher education programmes, optional subjects and specialization in new and renewable sources of energy areas have been introduced. There has also been insufficient emphasis on the interdisciplinary nature of new and renewable sources of energy technologies and their utilization. It is important to ensure that the educational process demonstrates the role of new and renewable sources of energy in development and its interlinkage with the development sectors and activities.

31. Except for a few countries, limited activities have been directed towards upgrading public awareness in new and renewable sources of energy areas. This has affected public acceptance of the technologies and slowed their widespread

dissemination. Greater attention should be given by Governments and the United Nations system to the crucial need for more public information and orientation.

5. Information flows

32. Progress has been made in the establishment and linking of new and renewable sources of energy information systems in developed countries and by the United Nations system. However, only a limited number of developing countries have established databases and/or information systems for new and renewable sources of energy. The Information Network on New and Renewable Sources of Energy and Technologies in Asia and the Pacific was established by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and FAO, which have played a key role in the interconnection of data banks. The United Nations University (UNU) has contributed towards improving access to documents generated in the developing countries by providing and distributing a publication entitled "Abstracts of selected solar energy technology" (ASSET). The utilization of available information by developing countries has been hampered largely by a lack of adequate retrieval systems and the fact that database facilities are usually located in developed countries. Efforts must be directed towards improving information flows between countries.

6. Rural energy supplies

33. In rural areas of developing countries, most of the energy supplies are based on traditional sources such as fuelwood, crop residues and dung. Commercial sources account for less than 25 per cent of rural energy consumption. Meanwhile, the population in those areas is growing fast and the pressure on traditional sources of energy is excessive and environmentally destructive.

34. Rural energy has been the focus of attention in many countries. Surveys have been undertaken covering a large number of villages in Asia and Africa. The surveys have provided data on energy consumption patterns and the availability of local resources and have indicated the scope for the introduction of new and renewable sources of energy technologies, plans and programmes needed to promote such technologies. Institutional and management aspects have also been examined.

35. Progress in the area of integrated rural energy development has taken place, as evidenced by the number of activities that have been undertaken covering various aspects of the rural energy situation. FAO has made efforts to focus attention on the new approach needed for integrated rural energy planning, emphasizing the role of new and renewable sources of energy in agricultural production, draught animal power, post-harvest applications, wood energy, biogas, cook stoves, water lifting and agro-industry, among others. Preliminary work has been done on the development of integrated rural energy

systems at the village and community levels. Planning studies and pilot integrated rural energy projects have been undertaken in several countries, providing insights into the relevant technical, economic and social parameters for decentralized energy planning.

B. Specific new and renewable sources of energy

1. Solar energy

(a) Resource assessment and planning

36. Some effort has been made to measure and estimate solar irradiance at the national and international levels. The World Meteorological Organization (WMO) has provided technical assistance and undertaken relevant studies. Additional effort is, however, required to cover those areas that have not been sufficiently surveyed and to develop simple and practical methodologies for assessing solar resources, including the development of appropriate databases.

37. On the basis of technological advances in solar energy technologies, solar energy was incorporated in the energy plans in some countries, particularly for water heating and remote area small-scale applications. However, widespread use of solar systems continues to be dependent on their economics compared to those for conventional energy sources. Consideration of social and environmental advantages of mature solar technologies could enhance their market penetration.

(b) Research, development and demonstration

38. Some solar technologies are considerably mature for applications; however, research and development activities are still being conducted to develop more efficient, reliable and low-cost technologies, as well as to develop more appropriate systems designs. Achievement during the past 10 years varies according to the specific technology, as described in the following paragraphs.

39. Low-temperature solar thermal technologies are among the most mature solar technologies. Significant progress has been made in the development of efficient solar collectors for water and air heaters. Solar heating components and systems have been commercialized in many developed and developing countries. Other applications such as crop drying distillation, as well as cookers for remote areas, are in advanced development phases. Solar ponds, pumping and low-temperature mechanical power still need more development and demonstration activities. Passive space climatization is attracting growing interest world wide and the United Nations Centre for Human Settlements (Habitat) (UNCHS) has prepared publications on the subject.

40. Medium- and high-temperature solar technologies have been the subject of intensive research, development, and demonstration projects for industry, and

other applications, such as thermal electricity generation, have been carried out. At present, advanced solar thermal technologies include parabolic trough concentrators with evacuated tube, and parabolic dish and heliostat systems. However, parabolic dish and heliostat systems still need further development in design, material efficiency and cost. Several power stations, totalling more than 400 MW, were installed using the parabolic trough technology. They are expected to reach techno-economic maturity and produce electricity at comparative costs in the near term. Further research, demonstration and extensive work are still needed for solar thermal power systems.

41. Photovoltaic solar technologies were the subject of significant research, development and demonstration programmes world-wide since the mid-1970s. Most of the effort has been directed towards the enhancement of cell efficiencies and the reduction of production costs through the use of new semiconductor materials and the development of advanced manufacturing techniques. Over the past 10 years, the price of photovoltaic modules and systems has been steadily falling in real terms, while module efficiency has been rising by a factor of three.

(c) Transfer, adaptation and application of mature technologies

42. Photovoltaic systems were widely demonstrated and tested in many developed and developing countries for various applications. They are beginning to make a significant impact, particularly for rural applications in developing countries. Photovoltaic systems are now economic for many off-grid applications and are expected to become increasingly so for larger applications. In recent years, particular interest has been shown in large-scale grid-connected photovoltaic electricity in Europe, Japan and the United States. As a result, production capacities have increased almost 10 times the level in 1981. Negotiations and consultations for the manufacture of photovoltaic systems in a number of developing countries are already in advanced stages.

43. Solar thermal technologies have been widely commercialized for low-temperature applications in many countries, both in urban and rural areas. Although their economics are site-specific, they can be competitive with conventional resources in most cases. Moderate- and high-temperature solar thermal technologies have been developing considerably for the supply of industrial processes heat and thermal electricity generation.

44. The viability of solar photovoltaic power stations is, however, based on the price forecasts of future photovoltaic systems. Small-scale photovoltaic systems for communications, lighting and other stand-alone applications have been widely used in different parts of the world, including developing countries.

2. Wind

(a) Assessment and planning

45. Many developed and developing countries have assessed their wind resources. In 1986, the Commission of the European Communities sponsored a study on the wind resource potential in Europe, identifying many sites. In 1989, it published a European wind atlas and a preliminary map of the Mediterranean basin. Under a UNDP project, 29 developing countries have been assessed for wind potential.

46. Most of the wind energy use for electricity production is concentrated in the United States, Europe and some developing countries. Approximately 20,000 wind turbines for electricity generation have been installed to date; the bulk of them are in California. Experience suggests that the most economical turbines are those with ratings between 100 and 350 kW. Most European Governments are subsidizing wind energy development as a result of environmental concerns and the security of supply. Various European countries instituted incentives and legislation for encouraging privately owned grid-connected turbines, and plans are well under way to install a total of 800-MW wind farms in a number of those countries.

(b) Research, development and demonstration

47. Research, development and demonstration activities have mostly been confined to industrialized countries. In the past four to five years, projects have been undertaken in joint development and demonstration activities in a number of developing countries with bilateral/multilateral assistance. Meanwhile, the Department of Technical Cooperation for Development of the Secretariat has given support to selected national research and development institutions involved with wind technologies. ESCAP and ESCWA initiated several wind demonstration projects, as well as a newsletter, in order to strengthen local research capabilities.

48. Some demonstration projects in developing countries have failed, mainly owing to the lack of effective follow-up in carrying out the full range of activities. A number of projects in Egypt, China and India, however, have led to a strengthening of local capabilities, technology transfer and local manufacturing.

(c) Transfer, adaptation and application of mature technologies

49. Most of the large wind-power systems are for electricity generation. Markets for irrigation or low wind speeds are largely undeveloped. Several developing countries in the Mediterranean region have installed wind turbines. Algeria, for example, has developed a hybrid system consisting of a diesel generator, photovoltaic panels and a 1 kW wind turbine. In Egypt, several wind turbines are in operation for water desalination and electric power generation. Morocco has a number of small-size wind turbines in service, and in Tunisia, wind turbines connected to local electric grids are in use. In China, wind turbine generators, ranging from 24 W to 200 kW, have been introduced.

3. Biomass

(a) Assessment and planning

50. The use of biomass is still crucial for the basic needs of the poorest people of the world. A majority of developing countries have taken steps to assess the biomass resource base, consumption and supply. At present biomass constitutes about 20 per cent of the developing countries' total energy consumption. Data availability has improved somewhat; nevertheless, biomass still does not figure systematically in the energy plans and programmes of many developing countries.

51. Although considerable progress has been achieved in industrialized countries in the use of biomass as a source of energy, poor rural areas and periurban areas, as well as arid and semi-arid zones of developing countries, face severe biomass stress requiring urgent national action. The donor community should provide additional resources for the solution of problems in these critical areas.

52. Additional resources are needed for the adequate implementation of the activities undertaken by FAO in rural energy planning and wood energy, by the Department of Technical Cooperation for Development in biomass assessment as part of its ongoing programme of assistance to countries in energy planning, and by ESCAP.

(b) Research, development and demonstration

53. Basic research on various aspects of biomass production, conversion and energy use have expanded substantially in the past decade. Research and development activities on fast-growing species of plants suitable for different agro-climatic regions have been undertaken in several developed and developing countries, as well as on harvesting techniques and equipment. Bioconversion technologies covering gasification, pyrolysis, liquefaction, carbonization, power generation, system studies etc. have been vastly expanded in several countries. Between 1983 and 1988, over 1,000 research, development and demonstration activities on such technologies were undertaken world wide.

(c) Transfer, adaptation and application of mature technologies

54. Application of mature biomass technologies, such as ethanol and methanol production, and direct combustion technologies for heat and power production seemed well poised to penetrate markets in the developing countries, especially after national agencies and multilateral financing institutions financed the large-scale ethanol programme in Brazil. However, the drop in oil prices has reduced their economic attractiveness. Despite this, some developed countries - notably the United States, Denmark and Sweden - have made increasing use of biomass residues for industrial and power generation, as is evident from capacity additions of about 400 MW in the past 10 years.

55. The densification of biomass to produce pellets and briquettes has been well established in Europe. However, the application of this technology on a large scale in the developing countries has faced technical and marketing problems. Projects have been undertaken in some countries with bilateral aid and with assistance from multilateral agencies, but the technologies supplied have not always been suitably adapted nor has assistance been given for local manufacture. However, in Brazil and India, where local capabilities for manufacturing equipment exist, densification technology is beginning to be applied and is well poised for further expansion.

56. Feeding surplus power to the electric grid through the application of bagasse cogeneration systems is receiving attention in many developing countries. Applications of biogas have also been undertaken in many countries. The technology has been disseminated in a variety of ways, including subsidies and supplies of raw materials. Larger biogas plants for community and industrial purposes have been built in some of these countries.

4. Fuelwood and charcoal

(a) Assessment and planning

57. The relative share of fuelwood and charcoal, in total energy consumption, has remained practically constant in the past 10 years. It is estimated that fuelwood and charcoal constitute 60 per cent of total energy consumption in Africa, 40 per cent in Asia and 30 per cent in Latin America and the Caribbean. It should be noted that in many countries of Africa, Asia and Central America, wood fuels represent more than 70 per cent of primary energy consumption, mainly for household and industrial uses. It is thus crucial for basic needs.

58. The wood energy situation is better understood today, owing to information and statistics gathered over the past 10 years. The main protagonists of wood energy systems, on the sides of both supply and demand, are clearly identified, and their roles are better defined than in the past. Although forest resources are beginning to be assessed and evaluated in a more systematic way, more effort should be made at the national, regional and interregional levels to improve information concerning the production and consumption of fuelwood for more effective wood energy plans.

59. At the beginning of the 1980s, during the "oil crisis", the use of wood fuels by poor people was seen as the cause of deforestation and desertification. It is now recognized that other factors such as farming, forest fires and the industrial use of forests are in many cases the chief causes of deforestation and that often wood fuels are only by-products of land clearance operations. Therefore, wood energy activities carried out in isolation, without the proper adjustment of agricultural/forestry activities, may not be sufficient to tackle the problem of forest destruction.

60. Considerable progress has been achieved in creating national capabilities, and most of the activities undertaken have focused on

strengthening research, training, education and fuelwood surveys. However, additional efforts are required, for instance, through the tropical forestry action programme, to create multidisciplinary groups capable of mastering the subject and to incorporate the active participation of non-governmental organizations into the planning and implementation of wood energy projects. Unfortunately, energy policies and planning have usually not given sufficient consideration to fuelwood and charcoal.

(b) Research, development and demonstration

61. Research on high-yield species and more productive wood energy plantations, using indigenous and exotic species, has received a great amount of attention and, at present, there is considerable experience and information in this area. Efficient cooking stoves for household use and improved techniques for making charcoal have also received considerable attention.

62. Activities aimed at developing the use of producer gas as engine fuel for decentralized power and electricity generation in rural communities, the use of ligno-cellulose residues, and briquette and pellet production are currently, from a technical point of view, well developed. However, wide dissemination of these technologies is largely affected by the present low price of fossil fuels.

(c) Transfer, adaptation and application of mature technologies

63. Activities on tree plantations using extension, agroforestry and community forestry schemes received support during the 1980s. But the management of existing forests has not received the required assistance. Experience gained in this field, particularly with respect to agroforestry and community forestry, is relevant and important for the implementation of future activities.

64. The distribution of improved cooking stoves and charcoal production techniques has received a great deal of support. Unfortunately, the results have not met expectations, and new approaches to the work in this field have to be developed. More attention should be given to activities relating to the health and environmental aspects of using wood fuels in households.

65. The dissemination of improved cooking stoves has received considerable support. The results of commercialized fuelwood markets have been successful in many cases, for example, the Kenyan "jiko" cooking stoves. In non-commercial settings, however, the results have not met expectations. Despite efforts by various entities of the United Nations system, few tangible results are available on the utilization of wood fuels for thermal energy in cottage, medium- and large-scale industries and enterprises. It has been realized that the use of wood fuels in the industrial, commercial and public sectors of developing countries requires additional study and attention by the international community, owing to its economic (income generation) and social (job creation) implications in rural areas.

5. Hydropower

(a) Assessment and planning

66. Compared with all new and renewable sources of energy, from commercial and non-commercial sources, hydropower is second only to biomass and, in terms of energy output, it takes first place. Less than half of the hydropower resources world wide are considered exploitable. The average increase in world energy production from hydropower plants during the period 1980-1989 was 19 per cent - 7 per cent in the developed countries and 54 per cent in the developing countries.

67. In the developed countries, hydropower plant utilization rates for large hydropower plants decreased after 1980 by 11.5 per cent because of the greater emphasis on load-following and momentary system control. In the developing countries, the decrease was 8 per cent, in part because of output restrictions suffered by some of the major installations, for example, Cahora Bassa in Mozambique and Inga in Zaire.

68. Many countries have not yet fully surveyed their small-scale hydropower potential. In its most recent survey, in 1989, the World Energy Council estimated a potential of 813 TWh (7 per cent of the total potential), of which 11 per cent had been exploited by 1989. The total capacity of mini/micro schemes rated below 1 MW is 9.25 GW world wide; this is equivalent to 1.5 per cent of the total installed hydropower capacity. An equal amount of small-scale plant capacity is currently in the planning stage.

69. Inventories of suitable hydropower sites have been established for many areas, and a vast catalogue of exploitable sites is available. The inventories are updated with new hydrological information. Many of the best sites have already been exploited, particularly in the developed countries where sites are conveniently close to demand centres. However, only a fraction of the sites that are already known have been developed. There is still a lack of knowledge of the potential of small sites in outlying areas and a need for additional surveys.

(b) Research, development and demonstration

70. Hydropower is a mature technology. There is, however, continuing research on the manufacturing side covering the application of new materials, designs and procedures; such work is limited to developing countries with a sufficiently large manufacturing base and an adequate market for their products, for example China and India. Demonstration schemes in small hydropower are sponsored by a number of United Nations agencies, mainly to offer experience and practical training and to test the value of hydropower development in rural and remote locations.

(c) Transfer, adaptation and application of mature technologies

71. Experience and modernization of hydropower plants have led to significant progress in design to improve the efficiency of water utilization, economy of construction and reliability and safety of operation. The two most significant technological improvements involve placing civil engineering works underground and utilizing very low heads of water. The latter has been made possible by the development of new turbines, the best known of which are the bulb turbines. New designs for low-head applications are still being developed, the incentive being better utilization of river flows and tidal and wave power, which involve very low heads. Technology transfer has enabled developing countries to take advantage of these technological advances, and several projects have adopted these new methods.

6. Geothermal energy

(a) Assessment and planning

72. Geothermal activity depends on regional and local geology. Plate tectonics has provided a basis for planning the exploration of geothermal energy resources. High-temperature geothermal resources suitable for exploration for large-scale electricity generation are likely to exist in 28 countries. In some of those countries, the resources have been proven and in some cases are currently under exploitation for both electricity generation and direct application. Geothermal resources for small- and medium-scale power generation may exist in 30 countries. The potential for direct application is much higher than for power generation in those countries. Progress has been made at the national level by some countries in the exploration and application of geothermal resources.

(b) Research, development and demonstration

73. Geothermal energy technology is already mature and is utilized on a significant scale. Research and development activities are being undertaken to achieve further progress on geoscientific and engineering aspects. The activities are multidisciplinary, involving geological, geochemical and geophysical methods. These activities require facilities and trained workers. Developing countries require assistance in developing capabilities for acquiring and adapting technologies suited to specific country situations.

(c) Transfer, adaptation and application of mature technologies

74. The Latin American Energy Organization (OLADE) has developed methods and guidelines for geothermal exploration and development that are useful for developing countries. They have been used by countries in Latin America, Asia and Africa, especially in geothermal projects supported by the United Nations system.

75. During the past 15 years the utilization of geothermal energy for electricity generation has increased significantly. The total installed geothermal power capacity world wide increased from about 1,278 MW in 1975 to about 5,876 MW in 1990. Moreover, the gap in installed capacity of geothermal energy between the industrialized and the developing countries has narrowed significantly. However, it should be noted that 81 per cent of the present geothermal power capacity in developing countries (1,955 MW) is installed in only two of those countries, Mexico and the Philippines, with El Salvador and Indonesia accounting for about 12 per cent. The remaining 7 per cent of the total installed capacity is in eight other developing countries. There is similar disparity in the industrialized countries, where 70 per cent of the installed capacity (3,920 MW) is in the United States and 28 per cent in Italy, Japan and New Zealand; the remaining 2 per cent is to be found in four other countries.

7. Draught animal power

(a) Assessment and planning

76. Consideration has been given to draught animal power as an energy source in the rural sector of many developing countries and as a basic energy input in agricultural planning. Basic data have been collected on the distribution of species, breeds, draught capabilities, the effect of energy on crop yields, agricultural implements, harnessing devices and existing draught animal power technologies.

77. Animal traction is currently receiving much attention in a large number of countries in Africa and Asia, with Governments, international and bilateral agencies, national and international research centres, universities and non-governmental organizations redirecting their agricultural policies towards a greater focus on small-scale farmers and their needs. However, the direction of national policies relating to the use of draught animal power in many countries is poorly defined, and this has severely hampered research planning. Frequently, different ministries are responsible for livestock, agricultural engineering, agronomy and socio-economic development, making it difficult to exchange information.

(b) Research, development and demonstration

78. Research and development activities have been undertaken in the design, development, testing and evaluation of agricultural implements, animal-drawn vehicles, harnesses and hitching devices so as to enhance the productivity of draught animals. Appropriate breeding schemes, draught animal feeding and management, fodder and the improvement of pastures have also been studied. The volume of research literature on draught animal power is, however, relatively small compared with that on animal production or on other types of agricultural traction. Most of the information on animal traction in sub-Saharan Africa and Asia focuses on historical reviews and case-studies,

implement design and testing, and socio-economics, with much less documentation available on the management, nutrition and working performance of draught animals.

79. However, over the past few years, recognition of the important role that draught animals play in agricultural systems and of the potential for increasing or improving the use of draught animal power technology among smallholders has resulted in the formation of national animal traction programmes in several African countries; they are now using multidisciplinary teams to carry out research, training and development. Research on draught animal power has been piecemeal. Moreover, animal traction research has often been carried out without a clear understanding of the biological and socio-economic constraints facing farmers in different agricultural systems. Preliminary efforts to determine whether the introduction or expanded use of draught animal power would be profitable or to identify factors that might limit its adoption or growth have frequently been omitted. In Asia, too, there has been a lack of coordination between livestock and mechanization programmes.

(c) Transfer, adaptation and application of mature technologies

80. One goal of the Nairobi Programme of Action is for the energy needs of rural areas to be met on a sustainable basis. To that end, priority action for transferring, adapting and applying improved techniques for utilizing draught animal power, including improved husbandry practices, are being promoted. Additional measures should be taken to support ongoing draught animal programmes in developing countries.

8. Ocean energy

(a) Assessment and planning

81. There has been little additional data on the extent of ocean energy resources in the past 10 years. Since interest in ocean energy technologies has not matched the expectations of the Nairobi Conference, little specific policy formulation or planning in that area has been undertaken.

(b) Research, development and demonstration

82. For open-cycle ocean thermal energy conversion systems, certain hurdles and challenges still exist, since less research effort has been devoted to them than to closed-cycle systems. Some positive results, however, have been achieved in the development of evaporators, condensers and turbines essential to open-cycle systems. Work has also been done on direct-contact heat exchangers, which are usually more efficient than surface condensers and yield higher power outputs.

83. Different wave-power concepts have been tested. However, only two have actually gone into medium-size demonstration - the multi-resonant oscillating

water column system and the tapered channel wave-power plant system, both developed in Norway. These systems are expected to receive further attention. There are indications that the interest in government-funded research on wave power has revived - for example, in the United Kingdom. The modular nature of wave-power technology could prove advantageous for developing countries because it would lower capital costs.

84. In 1984, the Commission of the European Communities prepared studies on wave and tidal power, ocean energy thermal conversion and offshore wind energy. In 1988, it initiated a programme for marine science and technology, including new and renewable sources of energy, worth 50 million European currency units (ECU). Within the United Nations system, UNDP conducted a pre-feasibility study on the utilization of wave energy for Cape Verde.

(c) Transfer, adaptation and application of mature technologies

85. In 1984, the Department of International Economic and Social Affairs of the Secretariat prepared a document entitled "Guide to ocean thermal energy conversion for developing countries", aimed at enhancing the transfer and adaptation of this technology. However, in the energy price climate of the past 10 years, financing has not been forthcoming.

86. Applications of tidal power have been limited by such factors as environmental impacts, high capital costs and a limited number of suitable sites.

9. Tar sands

(a) Assessment and planning

87. The locations of large accumulations of tar sands have been determined, but the quantities in place are not accurately known. Many of the tar sand deposits in developing countries are small and in remote localities, which makes exploitation difficult or, at the very best, expensive.

(b) Research, development and demonstration

88. China, Jordan, Trinidad and Tobago and Venezuela are the only developing countries in which evaluations of tar sand deposits have been carried out. Venezuela exploits tar sands commercially and has developed a process for making bitumen emulsion, which has been successfully tested as a substitute for coal in thermoelectric power plants. Further work is necessary to cope with the environmental consequences of the application.

(c) Transfer, adaptation and application of mature technologies

89. Canada is the only country in which energy fuel from tar sands has been commercially produced. The Canadian oil sands industry has reached an advanced stage of maturity, and the Alberta Oil Sands Technology and Research

Authority conducts international cooperative programmes, ranging from resource evaluation to bitumen upgrading. The Authority has joint programmes with Brazil, China, Jordan, Trinidad and Tobago and Venezuela.

10. Oil-shale

(a) Assessment and planning

90. Oil-shale deposits are known to occur in more than 38 countries, and oil-shale industries have existed in some of those countries at one time or another. At the present time, oil-shale is being utilized only in China, the Soviet Union and Israel. In the United States, a single oil-shale plant which had operated with subsidies for a few years has been closed down. A pilot plant has been in operation in Brazil for many years. Evaluations of oil-shale deposits for development potential have been conducted in India, Jordan, Morocco and Thailand. Only rough estimates of the grade and quantity of oil-shale deposits in the developing countries are available. Detailed investigations are necessary if economic evaluations are to be made.

(b) Research, development and demonstration

91. Project developments are continuing in Brazil, China, India, Jordan, Morocco and Thailand. Research should emphasize the environmental cost of utilizing oil-shale.

(c) Transfer, adaptation and application of mature technologies

92. Demonstrated technology exists for the mining of oil-shale, but the economics of its development remain uncertain, with many estimates indicating a price of over $50 per barrel of oil equivalent. No comparable estimates of the cost of electricity based on oil-shale are available, although it is known that two electric power stations of a combined capacity of 300 megawatts are in operation in Estonia.

11. Peat

(a) Assessment and planning

93. The total amount of peat resources has been estimated at 22 x 10^9 tons of coal equivalent. At least 40 countries are known to have peat. The principal users are the Soviet Union, Finland and Ireland. Precise statistics on current peat production are unavailable; however, it appears that the exploitation of peat has decreased in the past few years. There is no large-scale commercial peat production in the developing countries. However, studies carried out in Brazil, Burundi, Indonesia, Jamaica, Senegal and Sri Lanka have shown that production is technically possible with the machinery used in the developed countries. For large-scale production, some modifications would have to be made, owing to the different properties of the fuel and its environmental effects.

(b) Research, development and demonstration

94. Research is being undertaken in the artificial dewatering, gasification and liquefaction of peat. Several non-conventional techniques are receiving more attention by researchers. Finland and Sweden have comprehensive research programmes concerning peat production.

(c) Transfer, adaptation and application of mature technologies

95. Peat technology is well established for conventional peat production and use but might have to be adjusted to local conditions. In many countries it has recently been shown that, near consumption sites, peat provides cheap local fuel. Further work is necessary to cope with the environmental consequences of these applications.

96. In tropical developing countries, the production of both milled and sod peat has been studied. Projects have shown that peat can be produced technically and commercially. The projects have also provided valuable information on the properties of tropical peat.

97. At the International Peat Society Tropical Peat Symposium, held in Indonesia in 1987, a proposal was made to establish a tropical peat centre. The centre would promote and conduct research and technology transfer in the tropics. Some progress has been made to this end, but more international collaboration is needed in order to realize the programme.

IV. FACTORS BEARING ON THE IMPLEMENTATION OF THE NAIROBI PROGRAMME OF ACTION

A. Policy factors

98. In any given country, many factors bear upon policy formation with regard to new and renewable sources of energy; for example, exploitation and utilization of new and renewable sources of energy vis-à-vis national resource endowments; physical and geographical setting; organization of agriculture, industry and other relevant sectors; state of urbanization and socio-economic development; and the impact of changes in the international energy markets. The type, size and scope of programmes, projects and activities undertaken by the country, and through bilateral as well as multilateral cooperation, are also affected.

99. The policy environment during the latter part of the 1980s was unfavourable to the promotion of new and renewable sources of energy. The need for the longer-term approach emphasized in the Nairobi Programme of Action tended to be overlooked. Although countries acknowledged the need for greater reliance on new and renewable sources of energy in order to achieve a better energy mix, only limited efforts were made.

100. Energy pricing policies have had an important bearing on the implementation of the Nairobi Programme of Action. Policies that do not take full account of all relevant costs, place new and renewable sources of energy at a disadvantage. However, if conventional energy and renewable energy are compared in terms of all the relevant costs, including not only production and distribution but also environmental and social impacts, many new and renewable sources of energy technologies would prove to be economically attractive, even at the current levels of cost and development. It is only in recent years that such external costs have begun to be recognized, and their incorporation in cost calculations may tilt policies in favour of the expanded use of new and renewable sources of energy technologies in the future. So far, policies for encouraging private-sector investment in new and renewable sources of energy projects in a number of countries have been ineffective, owing to inadequate incentives and, in the case of producers, individual users and manufacturers of new and renewable sources of energy equipment, inadequate access to credit facilities or lease finance.

101. Rural energy has been identified as an area requiring priority action. Yet not much effort has been made to solve rural energy problems. Only the fuelwood problem has received some attention. On the whole, the role that new and renewable sources of energy could play in decentralized development has, in many cases, been overlooked in energy policy formulations. It should be noted that, in many cases, the role of new and renewable sources of energy in meeting energy needs in rural areas is essential since the rural population in the developing countries have very little access to hydrocarbon and other conventional fuels.

102. Technological advances in the field have enhanced the possibilities of new and renewable sources of energy in all economical development sectors. Attention should be given to the use of new and renewable sources of energy in urbanized and industrial activities, as well as in rural areas.

103. In the past two years, however, the attitude towards policy seems to have changed, largely owing to increasing concern about the environmental, social and economic consequences of the continued exploitation and use of fossil energy. The threat of global warming and global concern for sustainable energy development have rekindled interest in the development and utilization of new and renewable sources of energy and, therefore, the adoption of appropriate policies may have a strong bearing on the implementation of the Nairobi Programme of Action.

B. Institutional factors

104. At the national level, although as many as 120 countries have established national focal points for new and renewable sources of energy, with the exception of Brazil, China, Egypt and India, their roles have been limited. Governments are requested to staff and activate their focal points so that the latter can participate effectively in the coordination of new and renewable sources of energy development activities nationally and internationally.

105. Some developing countries established specialized institutional arrangements for new and renewable sources of energy. In China, India and Jordan, they are particularly extensive and effective. In China, a separate wing under the State Committee for Science and Technology is responsible for new and renewable sources of energy. A variety of institutional structures have been established for individual energy sources such as biogas, hydropower, solar energy, and geothermal energy at various levels. In India, Egypt and several other countries, a separate high-powered commission has been established for policy guidance to the working institutions. These types of institutional arrangements at the national level and their links with extension machinery have been helpful in the mounting of major national programmes. They are needed for promoting the large-scale application of new and renewable sources of energy. Many developing countries lack apex-level and downstream institutions of the type that have been established in China and India.

United Nations initiatives

106. The Committee on the Development and Utilization of New and Renewable Sources of Energy, established by the General Assembly, is entrusted with a number of functions, inter alia, to recommend policy guidelines for the entities within the United Nations system with regard to new and renewable sources of energy, and to formulate and recommend action-oriented plans and programmes for carrying out the Nairobi Programme of Action. The Committee is open to participation by all States. Its report, containing conclusions, decisions and recommendations, is submitted to the General Assembly through the Economic and Social Council. The decisions and resolutions of the General Assembly on the report of the Committee provide the basis for follow-up by the organs, organizations and bodies of the United Nations system and for appropriate action by Governments and the international community.

107. In 1982, in resolution 37/250, the General Assembly decided to establish secretariat arrangements for coordination functions and support services for the Committee on the Development and Utilization of New and Renewable Sources of Energy. The support arrangements have been implemented by the appointment of a special coordinator in the Office of the Director-General for Development and International Economic Cooperation, and by the establishment of a Section on New and Renewable Sources of Energy in the Department of International Economic and Social Affairs.

108. After 1981, various entities of the United Nations system initiated projects and programmes as part of the implementation of the Nairobi Programme of Action. The progress achieved has varied. Many of the entities have stated that a scarcity of resources - financial, human and equipment - has had a negative impact on the extent of their activities in the field of new and renewable sources of energy. The available resources are inadequate for any serious implementation of the many projects that would have to be undertaken in order to have the necessary impact.

109. At the regional and international levels, the Group of Experts recognized that, although the Committee on the Development and Utilization of New and Renewable Sources of Energy and the Section on New and Renewable Sources of Energy in the Secretariat, as well as the regional commissions, were supporting activities at the national level, current secretariat arrangements were insufficient for effectively carrying out other responsibilities regarding new and renewable sources of energy.

C. Inter-agency coordination

110. The General Assembly, in resolution 37/250, decided to establish an ad hoc inter-agency group on new and renewable sources of energy. The group would, inter alia, facilitate the coordination of activities within the United Nations system for the purpose of avoiding duplication of effort, eliminating bottlenecks in the implementation of the Nairobi Programme of Action and fostering cooperation among the various entities of the United Nations system on a continuing basis. The group would also monitor and coordinate information on activities outside the United Nations system, including, in particular, those on bilateral cooperation.

111. The Inter-agency Group on New and Renewable Sources of Energy of the Administrative Committee on Coordination has held 10 sessions, at which representatives of member organizations have exchanged information on their experiences and the implementation of specific projects in the field of new and renewable sources of energy. The sessions have provided an opportunity for representatives of the entities of the United Nations system to respond to the decisions of the Committee and the General Assembly regarding the implementation of the Nairobi Programme of Action. The importance of coordinating the activities of the United Nations system in the field of new and renewable sources of energy has been stressed by the Committee. The Committee has, however, noted that there is scope for further improvement.

D. Financial factors

112. The United Nations Conference on New and Renewable Sources of Energy recognized that the implementation of the Nairobi Programme of Action would require the mobilization of additional and adequate resources, and there was clear understanding that the magnitude of financial needs would be significant. While it was stated that each country would bear the major responsibility for developing its own new and renewable sources of energy programme, the developing countries would require international financial support for their national efforts, both public and private, from the developed countries, international financial institutions and other international organizations, as well as from developing countries in a position to provide assistance.

1. Financial requirements

113. No fixed target was established for investment requirements of new and renewable sources of energy in developing countries. However, as a starting point, the World Bank and UNDP were invited to undertake a joint study to estimate the financial needs for supporting actions and pre-investment activities in developing countries. The study came up with a rough estimate of $14.2 billion for the period 1982-1990 at 1982 prices. Of that amount, 72 per cent was for hydropower and geothermal energy, and the balance of 28 per cent for other new and renewable sources of energy. The foreign exchange share of these requirements was estimated to be 45 per cent, to be financed mainly through international assistance and support.

114. Some rough estimates were made by the Department of International Economic and Social Affairs of the Secretariat in the early 1980s, according to which $420 billion would be required for total investment requirements in new and renewable sources of energy in developing countries during the period 1982-2000. Of those requirements, about 84 per cent was expected to be the share of hydropower and only 16 per cent was for other new and renewable sources of energy - the latter amounting to an average of $3 billion per annum. Despite such heavy investment requirements, the energy gap of energy-importing developing countries was still expected to continue to increase.

115. Actual investments have fallen far short of estimated figures. In the early years of the decade, in line with the priority given to development of the energy sector, efforts were made to mobilize domestic and foreign resources for the implementation of new and renewable sources of energy activities. But after 1985, with reduced interest in energy transition investments in new and renewable sources of energy, investments declined sharply and many of the related projects were phased out or slowed down.

116. In that connection, it should be noted that public budgets for research, development and demonstration in renewable energies in the International Energy Agency countries - despite a revival of activities in some countries in recent years - declined sharply, from $1,665 million in 1980 to $487 million in 1990, at 1990 prices - a fall of about 70 per cent. The decline was more pronounced in the areas of mature technologies (such as solar heating and geothermal energy) and in technologies with little prospect for use in the near future (e.g., ocean energy). Moreover, the share of research, development and demonstration expenditures on new and renewable sources of energy was rather low compared with similar expenditures for other energy sources. The allocation for new and renewable sources of energy was 8 per cent of the total for the energy sector in 1990 (having declined from 14 per cent in 1980), as compared with 63 per cent for nuclear energy and 19 per cent for coal.

117. Similar sharp declines have taken place in new and renewable sources of energy expenditures in developing countries, partly owing to the keen competition from conventional sources of energy and partly to severe shortages

of capital, from both internal and external sources, for all types of investment programmes and projects. The declines differed for individual countries and by type of activity, even in areas where they were considered economically and technically feasible. In general, despite the considerable efforts made, the financial resources allocated to new and renewable sources of energy programmes during the past decade were so meagre that they could not make a significant impact on the economies of developing countries, at either the national or the local level.

2. Methods and sources of financing

118. The financing of programmes and projects on new and renewable sources of energy in many developing countries in the past has been carried out largely through external funding. In domestic financing, government budget allocations have played the most important role, either directly or through banking and other credit systems. The participation of the private sector appears to have been rather limited. External financing has come from both bilateral and multilateral sources and, among the latter, intergovernmental organizations and the United Nations system, especially the World Bank group and the regional development banks, have provided the bulk of financing. In bilateral financing, the bulk has come through official development assistance (ODA). Some funding has also come from private sources.

119. Available data show that, of the reported $36 billion that was funded for new and renewable sources of energy between 1980 and 1986, the largest share, about 26 per cent, came from domestic resources; of the balance, the United Nations system accounted for 25 per cent, intergovernmental organizations 16 per cent, bilateral sources 18 per cent, private sources 7 per cent, and unspecified sources the remaining 8 per cent. Hydropower accounted for about 75 per cent of the expenditures, followed by biomass, energy conservation, geothermal energy, energy planning, solar and wind energies and others.

120. The United Nations system has provided substantial amounts of financing for new and renewable sources of energy projects in developing countries. In recent years, however, the volume of such financing has declined, particularly if the contributions are calculated in real terms. Even the World Bank group, which appears to have maintained the high level of its financing in nominal terms (over $1.5 billion a year), the bulk of its commitment and contribution (about 70 per cent) has gone to hydropower projects and most of the balance to fuelwood.

121. The financing commitments of UNDP to new and renewable sources of energy projects amounted to $310 million during the past decade but declined from $37 million in 1983 to $20 million in 1990; in real terms, the decline was about 60 per cent. These commitments also cover the contributions of various funds managed by UNDP, including the Energy Account, the United Nations Sudano-Sahelian Office, the United Nations Capital Development Fund, the United Nations Special Industrial Services Programme, the United Nations Fund for Science and Technology for Development and the United Nations Development

Fund for Women. In general, all of these funds have sharply decreased their financing of new and renewable sources of energy in recent years.

122. The UNDP Energy Account, which had been conceived as an important channel of mobilizing additional resources for new and renewable sources of energy projects in developing countries, with the target of $100 million as its initial resource at the time of the Nairobi Conference, has faced a drastic decline in resource mobilization. During the period 1981-1990, its resource availability amounted to $40 million, of which 17 per cent came from voluntary contributions, 73 per cent from trust fund arrangements and 10 per cent from interest and other income. Since 1988, voluntary contributions to the Account have ceased and its reduced activities are now being funded mainly through trust fund arrangements, which declined to $2 million in 1990. As a result, its project financing has declined from $6.4 million in 1986 to $3 million in 1990.

123. As stated above, there were high expectations that the Energy Account would mobilize substantial additional financial resources. However, in view of changes in the international energy scene and reduced interest in new and renewable sources of energy activities, the Governing Council of UNDP, in July 1988, decided to close the Energy Office of UNDP and transfer the Energy Account to the United Nations Fund for Science and Technology for Development, in the form of a separate sub-account.

124. Another mechanism envisaged by the Committee for mobilizing additional financial resources for the implementation of new and renewable sources of energy projects has been consultative meetings. They were conceived as a flexible way of bringing together potential donors, recipients and interested organizations inside and outside the United Nations system. In the past, a number of meetings were held at national, subregional, regional and global levels. But in recent years, no such meetings have been organized, and their effectiveness has not been conclusively established.

125. A small fund, known as the United Nations Trust Fund for the Development and Utilization of New and Renewable Sources of Energy, was established in 1982 in the Office of the Director-General for Development and International Economic Cooperation. It was able to mobilize $2.5 million to finance a number of small projects.

126. As indicated above, financing for new and renewable sources of energy programmes and projects, despite the successes achieved in the early part of the 1980s, has declined in recent years. In the developed market economies, public expenditures for research, development and demonstration activities have been scaled down, and private involvement in new and renewable sources of energy investments has been greatly curtailed. In the developing countries, with the exception of a few countries, there have been similar trends, aggravated by the deterioration of domestic economic conditions in Africa and Latin America and the reduced availability of funding for new and renewable sources of energy activities from bilateral and multilateral sources, particularly in view of other needs and priorities.

127. However, there have recently been marked changes in perceptions of the global energy situation and its long-term prospects. Increasing concern about the environmental effects of expanded development and the use of conventional sources of energy has led to a revival of interest in energy transition, as recommended in the Nairobi Programme of Action. Undertaking remedial action to allay those concerns will require a renewal of efforts to mobilize additional and adequate financial resources for new and renewable sources of energy programmes and projects throughout the world, particularly in the developing countries.

E. Commercialization and marketing factors

128. Strategies for the commercialization of new and renewable sources of energy technologies play a vital role in establishing and expanding markets for such technologies. In seeking to evolve appropriate strategies for commercialization, it is essential to establish an information base concerning current and future demand, along with national policies on industrial production and licensing, prospects for local production, availability of raw materials and components, marketing facilities, availability of skills, servicing requirements and infrastructure, a research and development base etc. It is necessary for Governments to develop commercialization and marketing strategies for new and renewable sources of energy in their countries. Such strategies should address national needs for new and renewable sources of energy and be comprehensive and able to support, in a sustainable manner, the full range of activities of the commercialization process.

129. Several new and renewable sources of energy technologies were expected to reach the stage of commercial readiness and become marketable in the 1980s. Anticipating large market potential for such technologies in developing countries, bilateral donors and multilateral agencies supported projects involving supply of new and renewable sources of energy devices and systems for demonstration and field testing. Entrepreneurs hastily looked for marketing opportunities without going through the adaptive process for technology transfer. Project activities turned out to be isolated. Many projects were unable to fulfil their objectives because of a rapidly changing technology and market environment. The commercialization effort received a set-back owing to budgetary cutbacks in most developed countries for demonstration and commercialization projects. In the past five years, there has been a reduction in the number of enterprises engaged in new and renewable sources of energy technologies. The withdrawal of various tax rebates and concessions also had an adverse impact on the growth of new and renewable sources of energy industries.

130. Commercialization strategies followed by certain developing countries have focused on the diffusion of new and renewable sources of energy technologies based on the "extension" approach adopted widely in the agricultural sector. Those countries have adopted self-reliant approaches and developed technologies to suit their local conditions. Other promising

technologies are being introduced through national research, development and demonstration programmes in order to reach the "threshold" levels which are expected to generate demand and lead, eventually, to commercialization.

131. Commercialization efforts require institutional arrangements for financing projects as well as innovative strategies for harnessing public awareness, the enhancement of local industry, appropriate market evaluation and marketability schemes, together with facilitating regulations.

F. Techno-economic factors

132. Several new and renewable sources of energy technologies have reached the stage of "technical readiness"; however, the initial high cost of new and renewable sources of energy technologies has been the main deterrent to the wider utilization of those technologies. The economic viability of such technologies seemed attractive enough to be considered as potential oil substitutes, particularly when oil prices were relatively high; however, the drop in oil prices in 1986 and the softer conditions that prevailed thereafter, except during the Gulf War, affected the economic viability of several new and renewable sources of energy technologies. Those factors, together with the slow-down in economic growth of many countries, both developed and developing, adversely affected renewable energy development.

133. In view of current economic and environmental conditions, it is essential to evaluate the economic viability of new and renewable sources of energy technologies in real terms, including the social and environmental impacts of their use. Methodologies and tools for evaluating and qualifying the environmental and social impacts of new and renewable sources of energy should be further developed and applied.

134. During the past decade, the costs of several new and renewable sources of energy technologies have fallen substantially. The economic sensitivity of renewable energy projects has been found to be primarily a function of their technology, scale and location. Some financing agencies do not give due consideration to certain features of new and renewable sources of energy, such as short gestation time, larger employment potential, women's participation, environmental benefits, and improvement in health and sanitation in the rural areas of developing countries.

135. During the period just prior to the Conference and shortly thereafter, several large-scale projects were financed by national bodies and/or by assistance from multilateral agencies. Among the projects were the alcohol programme in Brazil, the dendero-thermal programme in the Philippines, the use of bagasse for electricity generation in Africa, and large solar-thermal power plants and windfarms in the United States of America. Solar power plants, windfarms and bagasse cogeneration projects have made significant headway owing to technology improvements and innovative financing. Certain large projects failed to succeed because expected technology breakthroughs did not occur.

G. Manufacturing capabilities and possibilities

136. The establishment and development of capacity at the national level for the manufacture, operation, maintenance, marketing and management of equipment and spare parts related to the use of new and renewable sources of energy were identified in the Nairobi Programme of Action as a priority area for action. International cooperation was expected to assist in facilitating the transfer and adaptation of technology which would enable manufacturing to be undertaken locally. In seeking to achieve these goals, developing countries face several obstacles and constraints. First, they face the uncertainties associated with the rapidly evolving nature of new and renewable sources of energy technologies and the broad range of choices - from solar-thermal, electric and photovoltaic systems and wind electric systems to wood stoves, biogas plants, biomass gasifiers and so on. Secondly, they face the problem of having to adapt those technologies to local conditions. They must also be prepared to provide infrastructure, trained workers, testing and standardization facilities, and marketing and service capabilities.

137. The capability to manufacture new and renewable sources of energy equipment varies from country to country. Major weaknesses exist in the areas of service and maintenance, marketing and management of equipment for decentralized applications. The less industrialized countries need assistance in order to enhance prospects for manufacturing.

138. The choice of technology and the scale of manufacturing are important considerations in ensuring successful manufacturing activities in developing countries. They need to have access to the tools and techniques of technology assessment used in the developed countries, not only to enhance their capability to enter into technology agreements but also to make more informed judgements about joint ventures with respect to such areas as appropriateness of technology, research and development requirements for adaptation and improvement, unpackaging of technology, quality control and standardization to suit local conditions.

139. Only a few joint ventures have materialized, in spite of the vast scope that exists. For example, active and passive heating technologies, biomass-based technologies and wind electricity generation are already widely used in the developed countries: Japan uses 5 million solar water heaters; and the technology is well established in Australia, Israel, Italy and the United States. Similarly, photovoltaic technology, devices and systems hold great promise for joint ventures. In the actualization of these possibilities, many inhibiting factors need to be addressed, such as the non-availability of specialized raw materials, infrastructural bottlenecks, poor research and development back-up and poor marketing and service capability.

140. Specific action to eliminate constraints for local manufacturing must be taken, such as building capabilities within developing countries to undertake technical developments and their effective application. Cooperation will be needed to strengthen design and engineering capabilities and establish appropriate institutions to promote manufacture, commercialization and application.

H. Socio-cultural factors

141. The Nairobi Programme of Action calls for actions that must take into account diverse socio-cultural situations. Issues to be addressed include ways of creating awareness, the transfer of technical and operational knowledge of new and renewable sources of energy technologies to people from different socio-cultural backgrounds and ensuring that the benefits reach the target groups. In seeking to assist countries in this respect, it is essential that attention be given to the following factors: tradition; social and economic disparities; race; religion; political structures, starting at the community level; values and beliefs; literacy of adults, youth, women and children; knowledge, attitudes and practices of health and sanitation; status of women; and acceptance of and compliance with new ideas and their adaptation. A lack of adequate attention to these factors could lead to the failure of an otherwise well conceived programme.

142. Some countries will need assistance in responding to local rural energy and rural development problems. The key issue is the integration of the energy requirements of rural populations into overall rural development, at the village level and at higher levels, with national energy plans and strategies. This calls for an intersectoral, interrelated, multilevel planning strategy, starting at the village level and working up to larger clusters and thereafter to national planning bodies.

143. Deep-rooted problems of income disparity, poverty, landlessness, seasonal employment, subsistence agriculture and socio-political strictures of class and caste contribute to a social milieu that is not conducive to the creation of a market-responsive situation. Programmes, therefore, need to overcome these socio-cultural barriers to development and seek out new and imaginative approaches. New and renewable sources of energy applications linked to income-generating activities and employment will need to be accorded higher priority. Socio-culturally compatible technological packages need to be developed and implemented, giving due attention to their acceptability, accessibility and affordability.

I. Environmental factors

144. Although environmental aspects were not among the main issues in the Nairobi Programme of Action, it was recognized that the envisaged energy transition should take place in a manner that would not cause harmful changes in the environment but would, in so far as possible, improve environmental conditions. The decade after the adoption of the Nairobi Programme of Action has, however, gradually raised scientific and political awareness of the adverse environmental consequences of present energy production and consumption patterns and put environment at the top of the energy agenda in most countries.

145. Many of the technologies utilizing new and renewable sources of energy have limited impact on the surrounding environment and some, for example

biogas production, may even have direct positive impacts. The direct environmental attraction of new and renewable sources of energy is therefore the avoided impacts from other energy sources when they are being substituted.

146. Fossil fuel utilization is known to have a number of adverse impacts on the environment at different stages of the fuel cycle; the most important of which are the emissions of a number of pollutants from the combustion process. Carbon dioxide is recognized as the main greenhouse gas and the emissions of CO^2 from fossil fuel combustion contributes more than half of the man-made build-up of greenhouse gases in the atmosphere. The Intergovernmental Panel on Climate Change has reported that this build-up of gases may lead to serious changes in global climate patterns, including increased temperatures, changed rainfall patterns and sea-level rise. Other emissions from fossil fuel use, such as sulphur dioxide and various oxides of nitrogen, cause acid precipitation which has very negative impacts on vulnerable freshwater ecosystems, forests, soils and infrastructures such as buildings.

147. It is, however, necessary to emphasize that not all new and renewable sources of energy are free from serious environmental impacts. Tar sands, oil-shale and peat cause problems similar to fossil fuels and are generally even more polluting. The unsustainable use of wood fuels, with their link to deforestation and desertification, was already considered in the Nairobi Programme of Action. Large hydropower and geothermal plants may have considerable site-specific impacts which need to be considered and, if possible, controlled or avoided.

V. RECOMMENDATIONS

148. Adequate energy supply is a basic prerequisite for the continued development of both developing and developed countries. New and renewable sources of energy have an important role to play in meeting future energy needs, in the rural and urban areas, and therefore their development and utilization should be given the highest priority. This has become particularly relevant in the light of increased awareness of the environmental impacts of conventional sources of energy.

149. The main thrust of the Nairobi Programme of Action and its recommendations continue to be valid. However, an overall review of its priorities may be required to reflect the changes that have taken place in the past decade in such areas as energy, ecology, finance, economic growth and the state of development and application of new and renewable sources of energy technologies. Priorities differ among countries depending on their resource endowment and their specific economic, technical and social circumstances.

A. Action at the national level

150. Policy commitments from all countries of the international community should be secured for concerted action for the realization of the objectives of the Nairobi Programme of Action.

151. Development of new and renewable sources of energy should be considered in the context of the overall development plans and priorities of each country and coordinated as an integral part of energy sector programmes in order to produce a perceptible impact and benefit to people. In this regard, programmes aimed at promoting awareness of new and renewable sources of energy within countries should be continued and strengthened, using various innovative media approaches.

152. Energy policies should provide reasonable and adequate incentives, measures and regulations for the development and use of new and renewable sources of energy. To reduce or eliminate distortions in favour of conventional sources of energy, all environmental and social costs should be incorporated in national energy planning and project appraisals.

153. Within the energy planning process, Governments should, consistent with their national priorities, establish time-bound commitments on the share of new and renewable sources of energy in total national energy consumption and attempt to allocate appropriate national funding to that end. In addition, countries should establish a target to increase the share of new and renewable sources of energy in overall energy consumption. Within the energy planning of countries, targets should also be established regarding widespread applications of new and renewable sources of energy. In that regard, a number of new and renewable sources of energy technologies that are mature, cost-effective and environmentally benign could serve as a basis for setting up targets, taking due account of the specific conditions of individual countries. Examples of target areas include the following:

(a) Rural energy supplies, particularly lighting and pumping and biogas applications;

(b) Low-moderate temperature solar application, specifically in the domestic and industrial sectors;

(c) Support planning, research and development programmes, as appropriate, to disseminate application;

(d) Fuelwood, charcoal and desertification programmes;

(e) Large-scale electricity production using solar and wind technology.

154. National government institutions at an appropriately high level responsible for the development and utilization of new and renewable sources of energy should be established or existing ones strengthened. It is fundamental that new and renewable sources of energy activities undertaken by

various national institutions be adequately coordinated. The establishment by individual Governments of national institutions should be complemented, when necessary, by cooperative arrangements at the subregional or regional levels, including the setting up of subregional or regional institutions.

155. Governments are requested to staff and activate their national focal points in order for the latter to participate effectively in the coordination of new and renewable sources of energy activities, at the national and international levels. Training programmes for the staff of the focal points should be implemented, with international support if required.

156. The mobilization of additional domestic financial resources will be needed in all countries for the development and utilization of new and renewable sources of energy, commensurate with their own possibilities. Governments are requested to explore suitable ways for such mobilization, including the reallocation of existing resources and generation of additional ones.

157. Adequate budgetary allocations should be made through national development plans for new and renewable sources of energy activities in order to ensure sustained efforts for the successful achievement of established targets and goals.

B. Action at the international level

158. The Committee on the Development and Utilization of New and Renewable Sources of Energy should be strengthened. Governments are invited to ensure the presence of high-level experts at the sessions of the Committee. Between each of the sessions of the Committee, the Secretary-General should be requested to organize a group of experts on new and renewable sources of energy at the global or regional level, as appropriate, to examine energy issues and possible priorities for consideration by the Committee. In this context, the group of experts, at its first meeting, should examine energy issues and, if possible, set targets and make recommendations.

159. In view of the expanded activities required in support of the Committee, especially concerning the scientific, technical, monitoring and coordination aspects of the development and utilization of new and renewable sources of energy, United Nations Secretariat arrangements should be strengthened accordingly. One measure could be for Governments to be requested to second technical staff.

160. Developing countries should be assisted, upon request, in the preparation and implementation of training programmes in the various areas of new and renewable sources of energy, including support to education and training institutions.

161. Developing countries should be assisted in strengthening or establishing capacities for assembling, manufacturing, testing and controlling the quality

of new and renewable sources of energy equipment and in the evolution of their maintenance and management services.

162. Assistance should also be given to developing countries in the development of credit and marketing facilities designed to promote the development and use of promising new and renewable sources of energy technologies.

163. With a view to enhancing the research and development of new and renewable sources of energy and in line with the recommendation of the Castel Gandolfo Colloquium of High-Level Experts on New and Renewable Sources of Energy, centres of excellence should be identified and strengthened and a network of those centres should be set up. Such a network should be linked to regional new and renewable sources of energy centres and networks.

164. The effective implementation of the Nairobi Programme of Action will require additional and adequate financial resources, commensurate with the achievement of the targets to be set at the national level.

165. The international community should assist the developing countries in the implementation of their new and renewable sources of energy programmes. A significant grant element would be required for the financing of supporting actions and preinvestment activities, and consideration should be given to setting up flexible repayment terms related to the financing of new and renewable sources of energy projects.

166. Bilateral cooperation institutions from developed countries should give high priority to new and renewable sources of energy development. They should support international cooperation in this area, in accordance with the national plans and priorities of the developing countries.

167. Multilateral financial institutions, including the World Bank group, the regional development banks and UNDP, should play a leading role in assisting the developing countries in the development of their energy resources, especially new and renewable sources of energy and consequently increase their contributions in that area.

168. Bilateral and multilateral institutions are requested to actively support the development of new and renewable sources of energy in particular by pursuing practices conducive to the assessment of energy projects on the basis of full-costing of environmental and social impacts, involvement of Governments in the development of new and renewable sources of energy projects, and implementation of incentives and other appropriate measures for development in this area.

169. The Governing Council of UNDP should be requested to consider revitalizing the Energy Account and converting it to an energy fund, as originally conceived.

170. Innovative efforts should be undertaken to secure financing of new and renewable sources of energy projects, such as third party cost-sharing and funds in trust arrangements. Participation of private capital should be strongly encouraged and, in this regard, the Multilateral Investment Guarantee Agency and the World Bank could play a useful role.

171. Attention should be given to the potential of the Global Environmental Facility (GEF) as a means of contributing to financing new and renewable sources of energy projects. Interested countries should be assisted in formulating suitable projects.

172. The international community should actively support new and renewable sources of energy activities carried out through economic and technical cooperation among developing countries.

Notes

1/ See Official Records of the General Assembly, Forty-fifth Session, Supplement No. 36 (A/45/36), annex, resolution 2 (V).

2/ Report of the United Nations Conference on New and Renewable Sources of Energy, Nairobi, 10-21 August 1981 (United Nations publication, Sales No. E.81.I.24), chap. I, sect. A.

3/ See report of the Secretary-General on the implementation of resolution 2 (III) of the Committee on the Development and Utilization of New and Renewable Sources of Energy at its third session (A/AC.218/15).

ANNEX

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